Stoller
Grand Junction Office established 1959

299-E33-41 (A4867)
Log Data Report

Borehole Information:

Borehole:	299-E33-41 (A4867)		Site:	216 B-7A and B Crib	
Coordinates (WA St Plane)		GWL[1] (ft):	256.9	GWL Date:	05/02
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
137369.94 m	573707.19 m	03/91	658.25 ft	263	cable tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
stainless steel (ss)	3.43	6.625	6.375	0.125	0	unknown
ss	0.9	N/A[3]	4	0.125	0.9	244.9
ss #10 slotted screen	None	N/A	4	0.125	244.9	261.0

Borehole Notes:

The casing depth information provided above is derived from *Summaries of Well Construction Data and Field Observations for Existing 200-East Aggregate Operable Unit Resource Protection Wells* (Ledgerwood 1992). Stoller personnel measured the 6-in. casing wall thickness and the outside diameter; the inside diameter is calculated. The casing thickness is estimated at 0.125 in. for both the 4-in. ID casing and the slotted screen. Groundwater level is derived from Stoller measurements from the top of the 6-in. casing at the time of logging. Coordinates and TOC elevation are derived from HWIS[4].

Logging Equipment Information:

Logging System:	Gamma 1D		Type: SGLS (35%)
Calibration Date:	07/01	Calibration Reference:	GJO-2001-243-TAR
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4 repeat	5
Date	05/28/02	05/29/02	05/30/02	05/30/02	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth	60.0	266.0	170.0	95.0	
Finish Depth	140.0	169.0	139.0	69.0	
Count Time (sec)	200	200	200	200	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	1.0	1.0	1.0	1.0	
ft/min	n/a	n/a	n/a	n/a	
Pre-Verification	AD001CAB	AD002CAB	AD003CAB	AD003CAB	
Start File	AD001000	AD002000	AD003000	A003032	

Log Run	1	2	3	4 repeat	5
Finish File	AD001080	AD002097	AD003031	A003058	
Post-Verification	AD001CAA	AD002CAA	AD003CAA	A003CAA	

Logging Operation Notes:

Spectral gamma logging was performed in this borehole during May 2002 on three separate days. Logging measurements are referenced to the top of the 6-in. casing and were started at 60 ft in depth. The interval above 60 ft was not logged because of the relatively large borehole diameter and thick annular grout. Logging began at 60 ft to locate the uranium detected in previous logging events. Data were collected at 1-ft depth increments at 200-s counting times. A data repeat section was collected between 69.0 and 95.0 ft to measure logging system performance.

Analysis Notes:

Analyst:	Henwood	Date:	07/26/02	Reference:	

Pre-run and post-run verifications of the logging system were performed for each day's log event. The acceptance criteria were met for the verification data. Post-run verifications were used for the energy and resolution calibration necessary to process the data.

A casing correction for 0.125-in.-thick casing is applied for the 5-in. stainless-steel casing and screen. A water correction is applied to data from 257 ft to the total depth of the borehole.

Each spectrum collected during a log run was processed in batch mode using APTEC Supervisor to identify individual energy peaks and determine count rates. Concentrations were calculated with an Excel worksheet template identified as G1DJul01.xls using an efficiency function and corrections for casing, and water as appropriate; no dead time corrections were necessary. The ^{214}Bi peak at 609 keV was used to determine the naturally occurring ^{238}U concentrations rather than the ^{214}Bi peak at 1764 keV. The 609-keV energy peak exhibited slightly better count rates than the 1764-keV peak.

Natural and processed ^{238}U are quantified independently. Natural ^{238}U is assessed from net spectral peak count rates for gamma rays associated with ^{214}Bi, a short-lived decay product of ^{238}U. Typically, the 609- or 1764-keV gamma-ray peaks are used. These assays will yield accurate ^{238}U concentrations only if ^{214}Bi is in secular equilibrium with ^{238}U. Considering the half-lives of the intervening members in the decay chain, a time period on the order of a million years is required for ^{214}Bi to reach secular equilibrium with ^{238}U. Therefore, activity of ^{214}Bi is assumed to be equivalent to natural uranium, which is presumed to have been undisturbed over geologic time. In some cases, this equilibrium may be perturbed by the deposition of ^{214}Bi as a short-term daughter of ^{222}Rn (a highly mobile gas and also a member of the ^{238}U decay series), which may accumulate in boreholes. As the ^{222}Rn dissipates, however, ^{214}Bi activity will decline to levels representative of the ^{238}U concentration in a matter of hours.

Chemical separation and processing of uranium involves the removal of impurities, including the ^{238}U decay products. After uranium has been purified, the longer lived decay products build up very slowly and no gamma activity from ^{214}Bi is detected in processed ^{238}U. Processed ^{238}U is quantified from net count rates for gamma rays (usually 1001 keV) associated with ^{234m}Pa, a short-term decay product that reaches secular equilibrium with ^{238}U within a brief time. The yield of the 1001-keV gamma ray is so low that the spectral peak is undetectable at typical background concentrations.

^{235}U decay is accompanied by emission of a 185.7-keV gamma ray. Because ^{235}U represents only about 0.7% of natural uranium, the overall intensity of this gamma ray in natural uranium is low, and the spectral peak is not observed at typical background concentrations. When ^{235}U is present in anomalous concentrations associated with processed uranium, the 185.7-keV gamma ray can be used for quantification. There is a potential for interference by the 186.1-keV gamma ray of ^{226}Ra, a long-term decay product of ^{238}U, but the intensity of this gamma ray is generally too weak to affect the ^{235}U assay.

Although ^{235}U and ^{238}U are chemically identical, ^{235}U may have been enriched (or depleted) relative to ^{238}U in processed uranium, and the relative proportions of the two isotopes may be helpful in evaluating the source of the processed uranium.

Log Plot Notes:

Separate log plots are provided for the man-made radionuclides (processed uranium [^{235}U and ^{238}U]) detected in the borehole, naturally occurring radionuclides (^{40}K, ^{238}U, ^{232}Th [KUT]), a combination of man-made, KUT, total gamma and dead time, and a repeat section plot. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, casing corrections, or water corrections. These errors are discussed in the calibration report. A separate log plot is provided that compares the Westinghouse Hanford Company (WHC) Radionuclide Logging System (RLS) data collected in 1991 and 1997 with the current SGLS log data.

Results and Interpretations:

Processed uranium was detected between 78 and 92 ft and from 118 to 243 ft in depth. In the upper interval the maximum ^{238}U concentration measured about 18 pCi/g at 88 ft. In the lower interval the maximum concentrations measured for ^{235}U and ^{238}U were about 35 and 675 pCi/g, respectively, at a depth of 239 ft. Other ^{238}U concentration peaks occur at 123 ft (41 pCi/g), 183 ft (83 pCi/g), 201 ft (116 pCi/g), 223 ft (247 pCi/g), and 230 ft (462 pCi/g). Between 78 and 180 ft in depth, where the measured ^{238}U and ^{235}U concentrations are near their respective MDLs of about 10 and 0.5 pCi/g, both radionculides may not have been detected at a depth interval. However, both isotopes probably exist where one or the other is detected because they are chemically the same, but one may be just below its MDL.

The KUT concentrations appear to be influenced by the well completion materials and are probably not useful for stratigraphic correlations between boreholes. For example, Ledgerwood (1992) indicates 8-20 mesh bentonite crumbles were emplaced to about 173 ft, where the ^{40}K increases and the ^{238}U and ^{232}Th concentrations decrease. A bentonite slurry was introduced from 173 to 240 ft and bentonite crumbles were emplaced from 240 to 243 ft, where the KUT logs show increases. Below 243 ft a silica sand pack was placed just above and adjacent to the stainless steel screen that was set to 261 ft.

A comparison log plot is included that shows data collected with WHC's RLS in 1991 and 1997 and the SGLS in 2002. The comparison suggests an influx of processed uranium into the area of the borehole from about 155 to 220 ft and increased concentrations between 220 and 240 ft occurred between 1991 and 1997. WHC reported that ^{125}Sb was also detected throughout the borehole in 1991; this radionuclide had decayed away by the second logging event in 1997. The 1991 logging event was conducted before well completion materials had been introduced into the borehole. The SGLS log data show good agreement with the 1997 data and suggest that no movement of contamination has occurred in the area since 1997.

Repeat log sections show good repeatability for depth and radionuclide concentrations, suggesting the logging system was operating properly.

It is recommended repeat logs be collected in this borehole at least twice per year as part of a borehole monitoring program.

References:

Ledgerwood, R.K., 1992. *Summaries of Well Construction Data and Field Observations for Existing 200-East Aggregate Area Operable Unit Resource Protection Wells*, Draft WHC-SD-ER-T12EAA, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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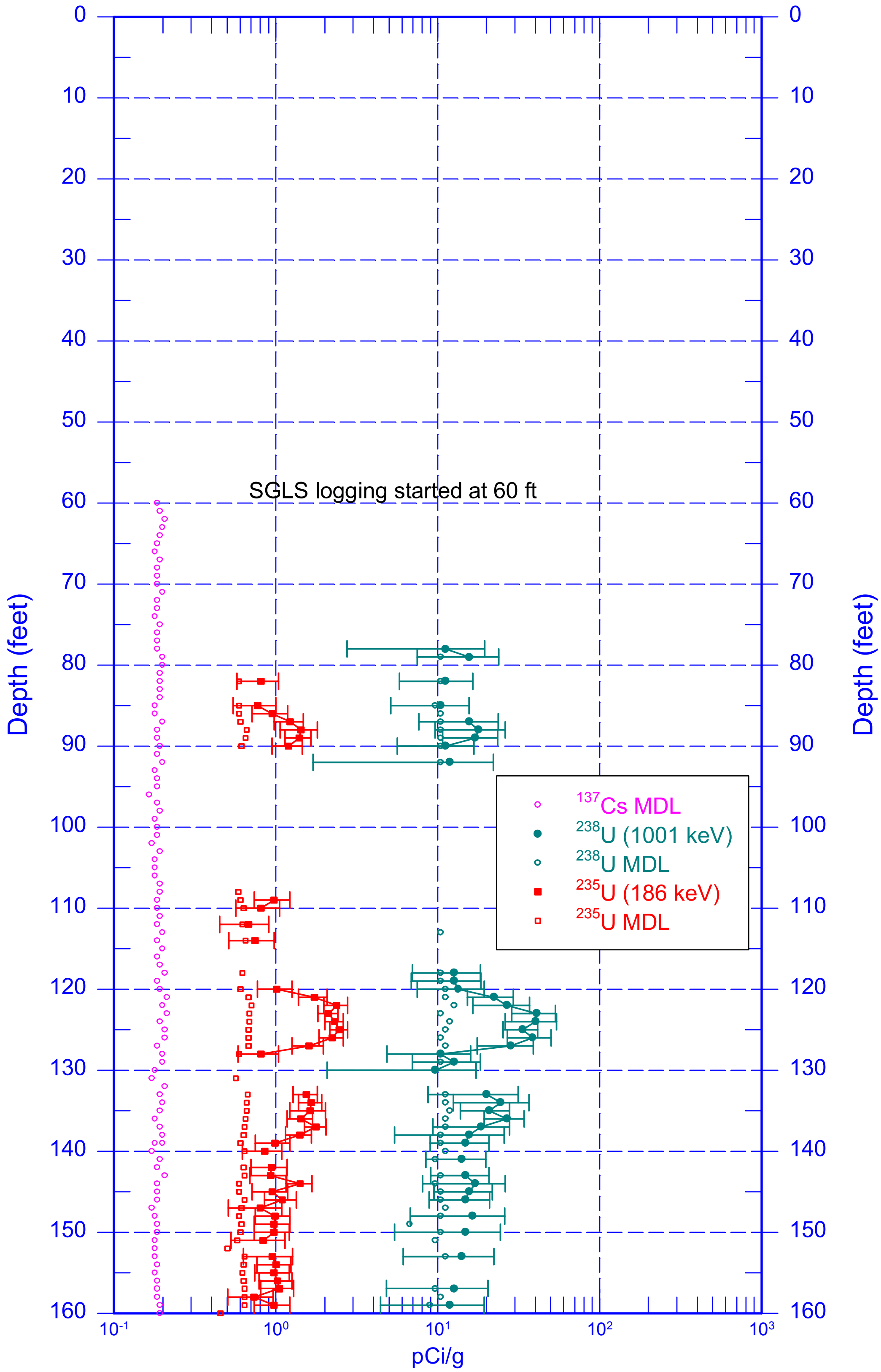
[1] GWL – groundwater level
[2] TOC – top of casing
[3] n/a – not applicable
[4] HWIS – Hanford Well Information System

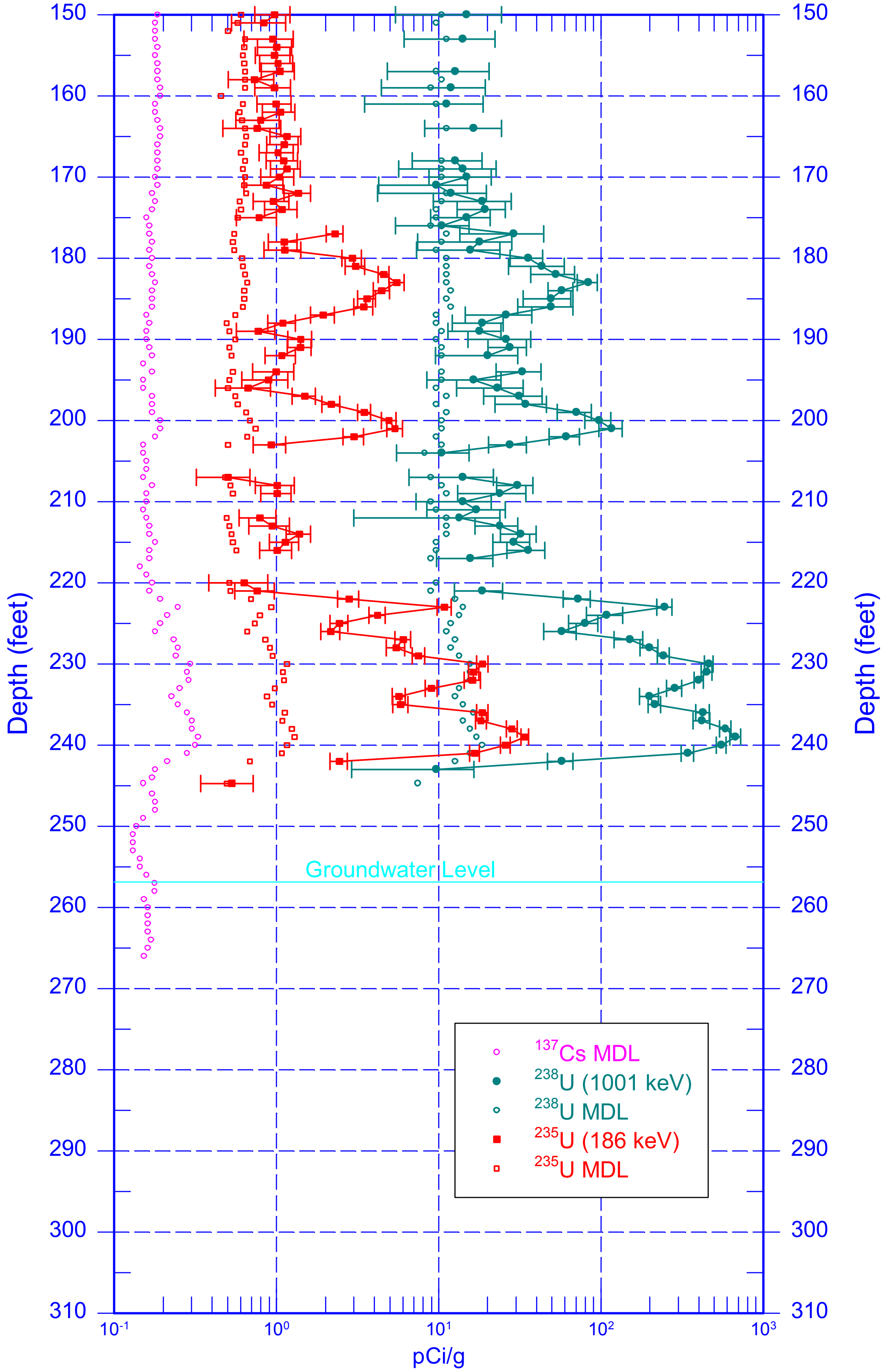
299-E33-41 (A4867)
Man-Made Radionuclides



Zero Reference - Top of Casing

Date of Last Logging Run
05/30/02

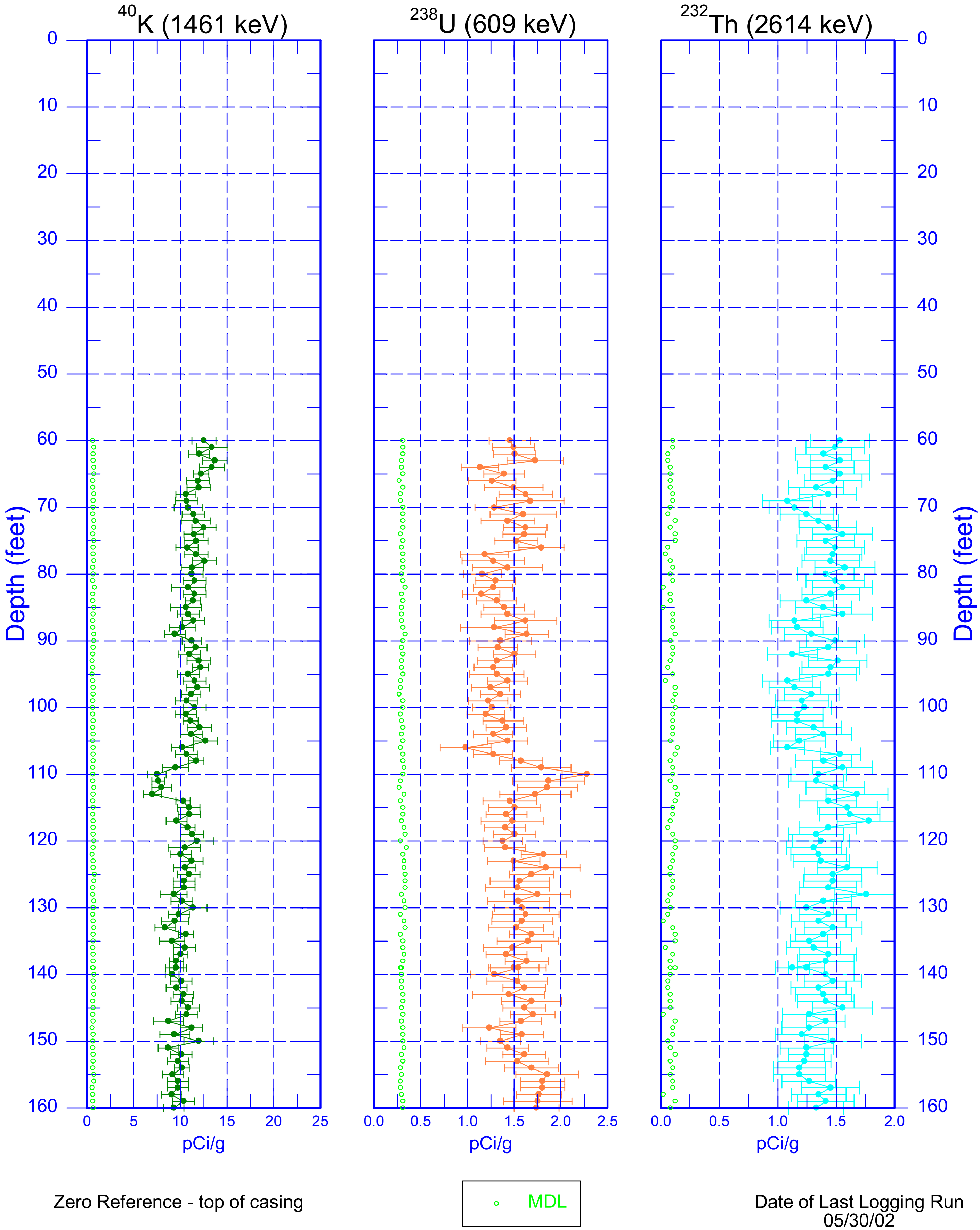
299-E33-41 (A4867)
Man-Made Radionuclides



Zero Reference - Top of Casing

Date of Last Logging Run
05/30/02

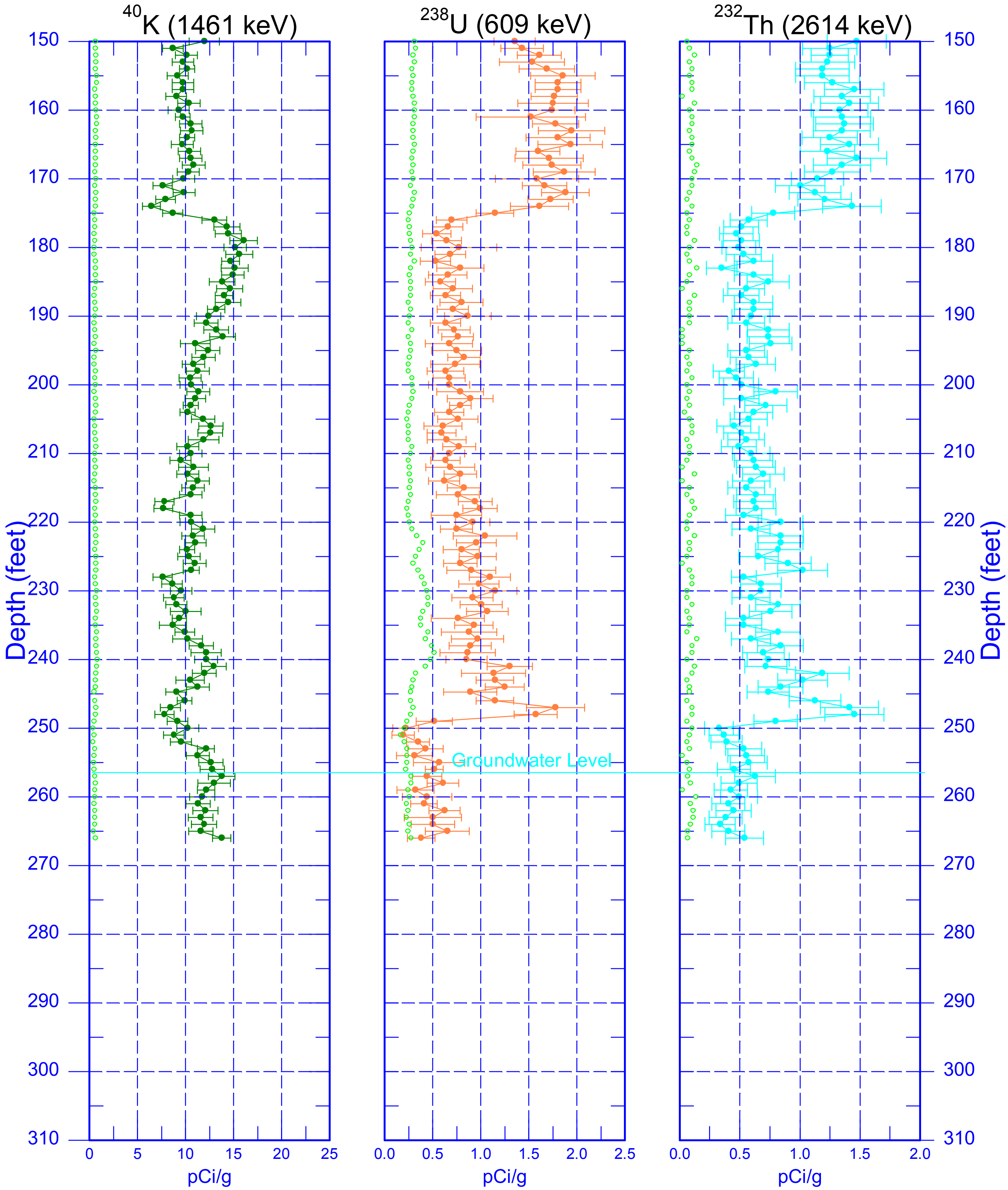
299-E33-41 (A4867)
Natural Gamma Logs



Zero Reference - top of casing

Date of Last Logging Run
05/30/02

299-E33-41 (A4867)
Natural Gamma Logs

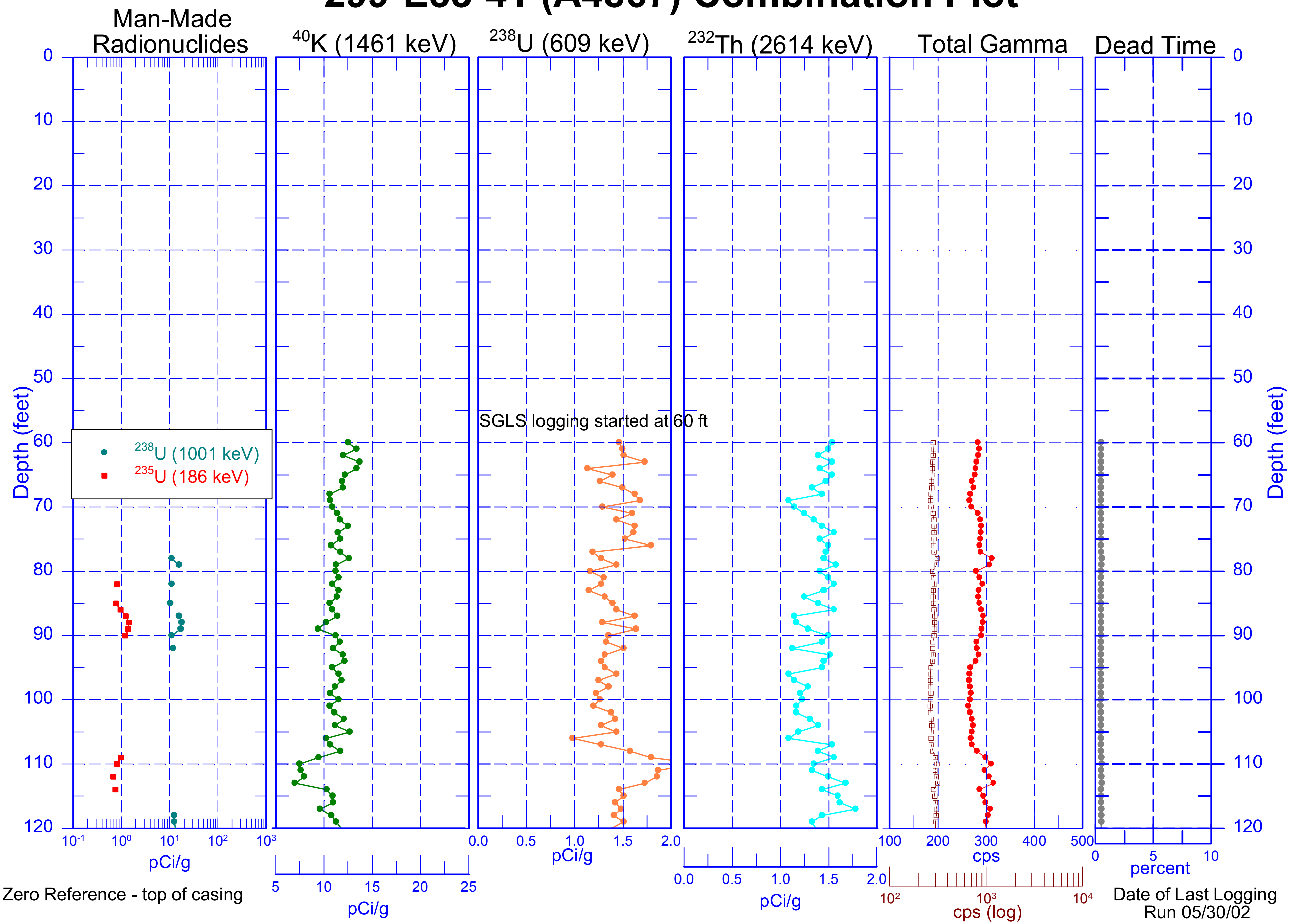


Zero Reference - top of casing

MDL

Date of Last Logging Run
05/30/02

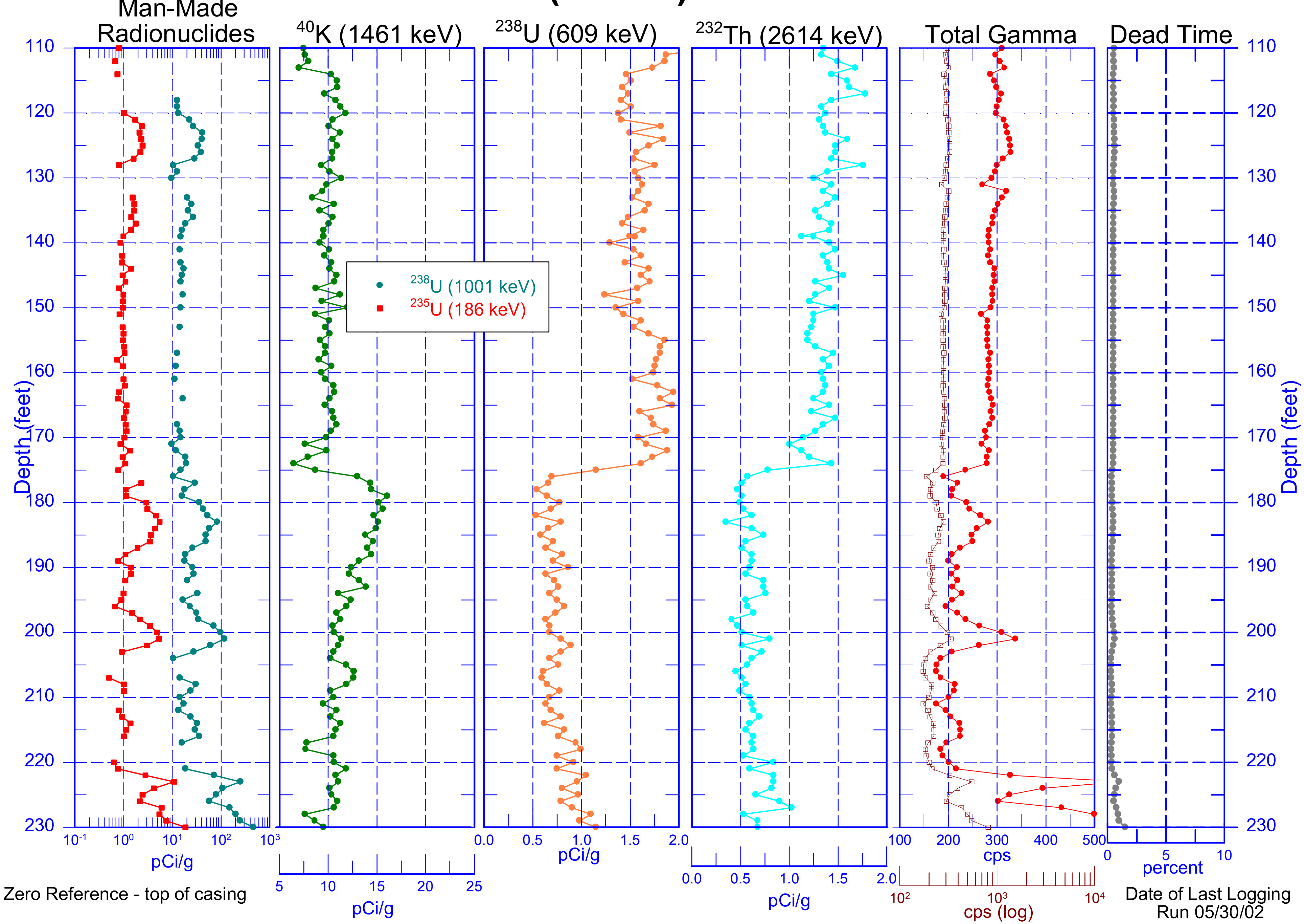
299-E33-41 (A4867) Combination Plot



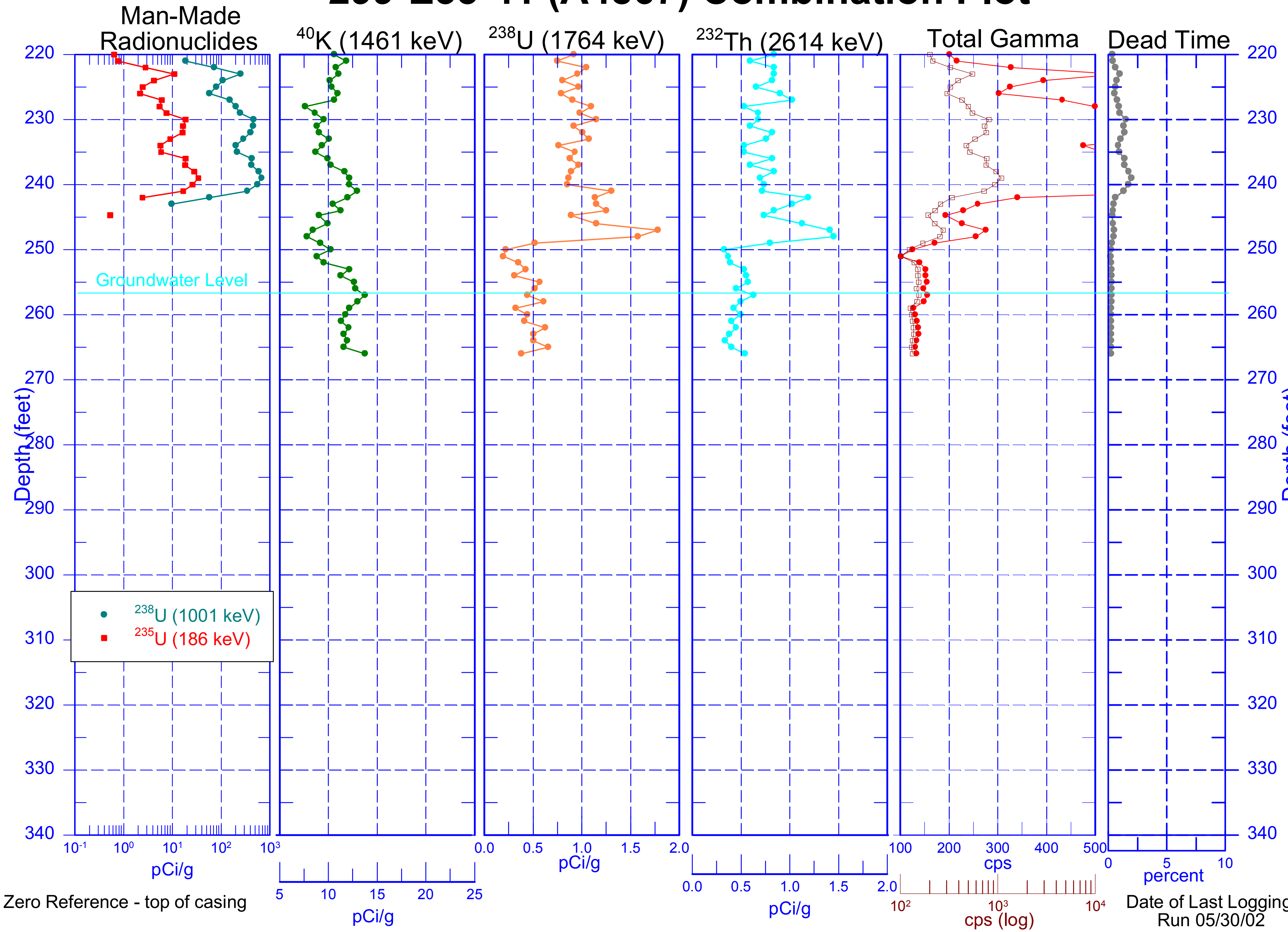
Zero Reference - top of casing

Date of Last Logging Run 05/30/02

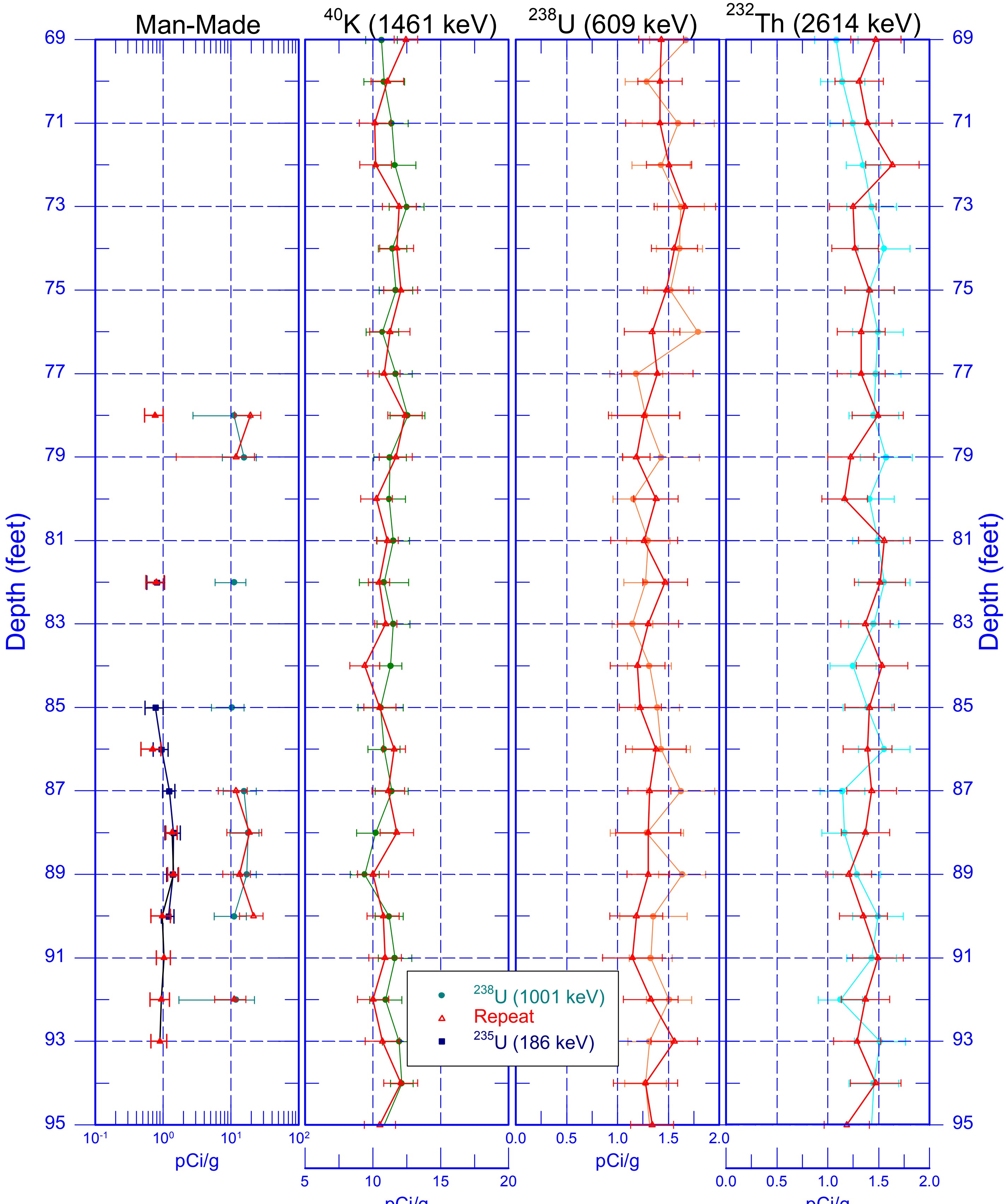
299-E33-41 (A4867) Combination Plot



299-E33-41 (A4867) Combination Plot



299-E33-41 (A4867)
Repeat Log Section



Zero Reference - top of casing

Date of Last Logging Run
05/30/02

299-E33-41 (A4867)
Man-Made Radionuclides Comparison Plot